Precodings for Transmission Rate Increasing in MIMO Single Carrier Block Transmissions

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summary

In wireless communication systems, multi-input multi-output (MIMO) wireless, which exploits the spatial diversity, is known as a cost-effective solution for high data rate. In the MIMO systems, the linear precoder and decoder, which is the joint processing at the transmitter and receiver sides and decomposes the MIMO channel to the parallel flat fading subchannels i.e., eigenmode, is introduced to achieve performance improvement[1], [2].

Under the assumption that the channel state information is known, the linear precoder is designed in accordance with various criteria, i.e., the maximization of the output capacity[3], [4], the minimization of the mean square error (MSE) and weighted MSE[5], [6] and the minimization of a probability of error[5], [7], [8]. In various criteria for reducing the probability of error, maximum likelihood (ML) decision rule based criterion precoder (ML precoder)[5] minimizes the probability of error by maximizing the minimum distance between symbol hypotheses and is designed to keep the bit error rate (BER) at the maximum tolerable BER[3] by discarding the eigenmode which is unaccepted the maximum tolerable BER condition, at last, the number of remainder eigenmodes, i.e., useful eigenmodes, determines the transmission rate. However, when the maximum tolerable BER is chosen to be a low value($\approx 10^{-9}$), the number of the useful eigenmodes will be seriously constrained. As a consequence, the transmission rate may be decreased.

In this paper, for the MIMO block transmission systems, we propose a precoding method aiming at increasing the transmission rate. In order to increase the transmission rate, we employ two kinds of the ML precoder. One is conventional precoding method with the ML precoder which has a precoded symbol length equal to a frame length(CPC). Another one is a novel precoding method, in which several ML precoder are arranged in parallel(PPC). The ML precoder employed in the PPC is designed using the MIMO channel matrix consisted of the direct wave only are arranged in parallel and has a precoded symbol length equal to the number of transmit antennas. The precoded symbols for one frame is constructed of the precoded symbols generated from each ML precoders, at last, the precoded symbol length of the PPC is the summation of the precoded symbol lengths of each ML precoder in the PPC and equal to the precoded symbol length of the CPC.

We investigate the effect of the precoded symbol length of one ML precoder on the resulting transmission rate and show that the transmission rate increasing can be

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achieved by switching the precoding method with higher transmission rate depending on the channel conditions. Also, since the proposed method require to design two types of the ML precoder, the computational cost is very high. In order to reduce the computational cost in the proposed method, we propose a computationally efficient ML precoder switching algorithm which requires only some lower bounds of the extreme eivenvalue.

The effect of the proposed method is proved theoretically, also its validly is demonstrated by the computer simulations.

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